REMARKS

Claims 38 and 45-61 are pending in the present application. In the Office Action dated December 15, 2004, the Examiner rejected claims 38 and 45-59 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,593,174 to Blanchard ("the Blanchard patent"). Claims 38, 45, 46, 49, 52-54, 57, 60 and 61 were rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,362,510 to Gardner et al. ("the Gardner patent"). Claims 38, 49-52, and 57-59 have been amended. Amendments to dependent claims 49-51 and 57-59 are to provide a proper antecedent basis for claim terms as a result of the amendment to independent claims 38 and 52. Claims 60 and 61 are cancelled.

The embodiments disclosed in the present application will now be discussed in comparison to the cited references. Of course, the discussion of the disclosed embodiments, and the discussion of the differences between the disclosed embodiments and the cited references, do not define the scope or interpretation of any of the claims. Instead, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

The embodiments disclosed in the present application are directed to processes and devices including selectively formed contacts for electrically interconnecting components on an integrated circuit. The contacts have an increased vertical growth rate relative to a lateral growth rate during formation of the contacts. In this way, adjacent contacts may be formed in integrated circuits having reduced dimensions of components forming the integrated circuit since the lateral growth rate of the contacts will not cause adjacent contacts to electrically short circuit. Figure 2 of the present application illustrates an overall process of selectively forming contacts 200-204 on a substrate 206 according to one embodiment of the present invention. To begin the process, a selective epitaxial growth (SEG) process is started, causing the contacts 200-204 to begin forming over the regions 214-218, respectively. At the same time, electromagnetic radiation 208, or some other type of directed thermal energy, is applied to begin heating upper surfaces 220 of the contacts 200-204. The radiation 208 heats the upper surfaces 220, causing a vertical growth rate 226 of each contact 200-204 to increase relative to a lateral growth rate 228 of the contact. The lateral growth rates 228 of each contact 200-204 do not increase significantly because the intensity of the radiation on sidewall surfaces 222, 224 is small relative to the

intensity on the upper surfaces 220. As a result, the contacts 200-204 grow at a faster rate in the vertical direction 226 than in the lateral direction 228. The relatively smaller lateral growth rate 228 results in less lateral growth of each contact 200-204 during the time the contact is being formed. The reduced lateral growth rate 228 relative to the increased vertical growth rate 226 enables contacts 200-204 to be selectively formed having a desired height H in semiconductor integrated circuits having reduced lateral spacing between devices. As seen in the example of Figure 2, the reduced lateral growth of the contacts 200 and 202 results in the contacts being formed only slightly over the isolation oxide region 210, while the increased vertical growth rate 226 enables the contacts to be grown to the desired height H. In Figure 2, the surfaces that are significantly heated by the applied radiation 208 are indicated via the thicker lines.

Accordingly, each contact 200-204 exhibits a single crystalline structure due to being epitaxially grown, and an arcuate, convex upper surface 220 and sidewall surfaces 222, 224 that are substantially perpendicular to the substrate 206. Thus, the resulting contact 200-204 exhibits a structure that is different than that of a conventionally formed contact shown in Figure 1.

The examiner has cited the Blanchard patent. Figures 3 and 4 show an in-process semiconductor device having a semiconductor substrate 102 with a patterned first dielectric portion 110 grown thereon. Following growth of the first dielectric portion 110, a second dielectric portion 112 is grown and patterned, leaving an exposed surface portion 122 on the semiconductor substrate 102. As shown in Figure 4, a layer of semiconductor material 124 is formed over dielectric layer 108 defined by the first dielectric portion 110 and the second dielectric portion 112, and formed over the exposed surface portion 122. The layer of semiconductor material 124 conforms to the geometry of the dielectric layer 108. The layer of semiconductor material 124 is formed by selective epitaxial growth in some regions, and in other regions is formed to exhibit a polycrystalline structure. However, the layer of semiconductor material 124 that is epitaxially grown does not exhibit an arcuate, convex upper surface that is intersected by generally planar sidewalls that are perpendicular to the semiconductor substrate 102.

The examiner has also cited the Gardner patent. Figure 3 shows an in-process semiconductor device which includes a semiconductor substrate 100 having an upper oxide layer

102 with a groove 104 defined therein. As shown in Figure 4, a silicon epitaxial layer 104 is deposited within the groove 104 and not upon the oxide layer 102. As shown in Figure 5, after depositing the silicon epitaxial layer 104, dopants 110 are implanted into the silicon epitaxial layer 106. As shown in Figure 6, after implantation of the dopants 110, the in-process semiconductor device is annealed (represented by thermal radiation 114) to anneal out ion implant damage.

While, the Gardner patent discloses forming the silicon epitaxial layer 104 using selective epitaxial growth, no incident electromagnetic radiation, or some other type of directed thermal energy, is applied to heating upper surfaces of the silicon epitaxial layer 104 during formation to result in a high aspect ratio structure having an arcuate, convex upper surface with generally planar sidewalls that are perpendicular to the semiconductor substrate 100. Instead, the Gardner patent merely employs conventional selective epitaxial growth and makes no mention of using a directed electromagnetic source of energy to heat the upper surface of the silicon epitaxial layer 104 during epitaxial growth. In order to establish inherency, the examiner must show that the silicon epitaxial layer 104 necessarily has an arcuate, convex upper surface with generally planar sidewalls that are perpendicular to the semiconductor substrate 100. (See, M.P.E.P. § 2112). The portions of the Gardner patent cited by the examiner (Col. 8, line 63-Col. 9, line 15) to purportedly show the use of a collimated electromagnetic radiation source merely discloses that the silicon epitaxial layer 104 can be deposited using a conventional reactor which heats the substrate 100 using infrared (IR) or radio frequency (RF) heating. Again, since the Gardner patent makes no mention of using a directed electromagnetic source of energy to heat the upper surface of the silicon epitaxial layer 104 during epitaxial growth, it is not inherent in the disclosure of the Gardner patent that the silicon epitaxial layer would necessarily exhibit an arcuate, convex upper surface with generally planar sidewalls.

Turning now to the claims, the patentably distinct differences between the cited references and the claim language will be specifically pointed out. Presently amended claim 38 recites "[a]n in-process substrate structure including a plurality of contact regions and a plurality of non-contact regions adjacent the contact regions on a surface of the substrate, the in-process substrate structure comprising: a selectively formed single crystal contact on each single crystal contact region, each single crystal contact being isolated from single crystal contacts on adjacent

contact regions, each single crystal contact having *an arcuate, convex upper surface intersected by two sidewall surfaces, the two sidewall surfaces being substantially perpendicular to the surface of the substrate.*" Neither the Blanchard nor Gardner patent discloses or fairly suggests a selectively formed contact having a single crystal structure and further having an arcuate (*i.e.*, curved like a bow), convex upper surface intersected by two sidewall surfaces, the two sidewall surfaces being substantially perpendicular to the surface of the substrate as required by claim 38. If the layer of semiconductor material 124 disclosed in the Blanchard patent is considered an electrical contact for the sake of argument, the layer of semiconductor material 124 does not have the geometry required by claim 38. Furthermore, the Gardner patent also fails to disclose the geometry of the electrical contacts required by claim 38. Claims depending from claim 38 are also allowable due to depending from an allowable base claim and further in view of the additional limitations recited in the dependent claims.

Presently amended claim 52 recites "[a]n in-process semiconductor structure, comprising: a substrate; a plurality of active regions; a plurality of isolation regions adjacent the active regions, each isolation region being positioned between adjacent active regions to isolate adjacent active regions; and at least one selectively formed single crystal contact on each active region, each selectively formed single crystal contact being isolated from single crystal contacts on adjacent active regions, each selectively formed single crystal contact having *an arcuate, convex upper surface intersected by two sidewall surfaces, the two sidewall surfaces being substantially perpendicular to an upper surface of the active region.*" Neither the Blanchard nor Gardner patent discloses or fairly suggests a selectively formed contact having a single crystal structure and further having an arcuate, convex upper surface intersected by two sidewall surfaces, the two sidewall surfaces being substantially perpendicular to an upper surface of the active region as required by claim 52. If the layer of semiconductor material 124 disclosed in the Blanchard patent is considered an electrical contact for the sake of argument, the layer of semiconductor material 124 does not have the geometry required by claim 52. Furthermore, the Gardner patent also fails to disclose the geometry of the electrical contacts required by claim 52. Claims depending from claim 52 are also allowable due to depending from an allowable base claim and further in view of the additional limitations recited in the dependent claims.

All of the claims remaining in the application (claims 38 and 45-59) are now clearly allowable. Favorable consideration and a timely Notice of Allowance are earnestly solicited.

Respectfully submitted,

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